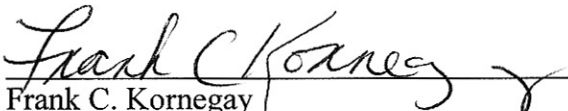


**Center for Nanophase Materials Science  
Environment, Safety and Health Plan**

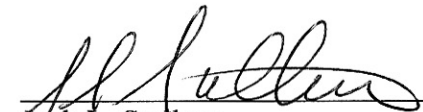
**September 2002**

  
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Date 30 August, 2002

  
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Date 8/30/02

  
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## **CNMS ENVIRONMENT, SAFETY, and HEALTH (ES&H) PLAN**

### **1. Overall Expectations**

The CNMS shall be designed, constructed, and operated in such a manner to protect the safety of workers, the public, and the environment. This shall be accomplished by:

#### 1.1 Providing design features consistent with the SNS Environmental Assessment (EA).

Designing systems and structures to minimize waste generation and to accommodate decontamination and removal in accordance with the project's decommissioning plan to the greatest extent practical. Design features to be considered shall include volume reduction of waste, avoiding pockets in corners where frequent decontamination is likely, and providing liners or suitable coverings on appropriate walls to prevent activity from being absorbed deeply into the wall and to allow removal during decontamination. Guidance on design to minimize waste and pollution is provided.

#### 1.2 Incorporating an Integrated Safety Management System Policy that implements the DOE Policy, DOE P 450.4, Safety Management System Policy

#### 1.3 Adhering to the ORNL Work Smart Standards (WSS):

- ORNL approved WSS for Engineering Design for Standard Industrial, Radiological, Non-reactor Category 2 and 3 Nuclear and Accelerator Facilities
- ORNL approved WSS for construction and construction-like activities, and;
- ORNL approved WSS for Other Industrial, Radiological, and Nonradiological Facilities;

You can find the approved ORNL WSS on the ORNL server at the following URL:

<http://eshtrain.ct.ornl.gov/SBMS/WSSHome/standards.cfm>

#### 1.4 Controlling hazards by eliminating them whenever practical. Where eliminating hazards is not practicable, controlling them by passive means is preferred.

#### 1.5 By following industry consensus standards, unless required by CNMS-specific features and alternative requirements are approved by the appropriate lead engineer.

#### 1.6 Implementing the Jacobs construction safety program to ensure worker safety on the CNMS site during construction and initial system testing.

#### 1.7 Incorporating energy conservation features into the design of CNMS facilities as required by 10 CFR 435.

#### 1.8 Performing Independent Design Reviews on systems, structures, and components.

## **2. Hazard Identification and Control**

CNMS structures, systems, and components shall provide adequate assurance of safety against hazards, including those identified in Table 2-1. This table identifies hazards known to exist or have the potential to be applicable to the conceptual design, lists safety features designed to mitigate them, and, in some cases, gives the design criteria governing those features. Regardless of whether design criteria are specified in the Table, designers shall assess, understand, and control the hazards posed by the systems, structures and components within their scope.

Table 2-1 Hazard Identification and Screening

Hazard	Measure	Action Decision*	Action Decision Basis
RAD Waste	>0.002 $\square$ Ci/g	Screen Out	Not planned
Radioactive Materials (including fissionable materials)	>Levels in Title 40 CFR Part 302.4 Appendix B >Levels in ORNL NCSP NCS-1.0	Screen Out	Not planned
X-ray	Doesn't meet ANSI X-ray standards	Screen Out	Laser laboratories will be designed and operated to applicable ANSI standards
Toxic Materials	>Levels in Title 40 CFR Part 302.4	N/A	
Reactive Materials	Hazard level $\geq 2$ and > 10 lbs.	Keep	Expect between 10 and 20 lb. reactive metals in laboratories and storage areas
Flammable Materials	>110 gal (Two 55 gal drums)	Keep	Total in facility >110 gal but much less than 110 gal in any individual 2-lab fire area.
Explosives	Any High/Class A or B	N/A	
	>10 oz. Of low in one area (Class C)	N/A	
Chemical Incompatibility	$\geq 2$ Incompatible chemicals in same area and > 1 kg.	Keep	Laboratory quantities in use, following OSHA Laboratory Standard
Lasers	Class III nonenclosed beam and/or Class IV	Keep	Use will be in accordance with applicable ANSI standards
Electrical Voltage/Current	600V and >25mA output, 50J stored energy at 600V	N/A	
Kinetic Energy	"Unique", i.e., high energy flywheel	N/A	
Pressure	>3000 psig	N/A	
	>0.1 lb TNT equiv. Energy	N/A	
Temperature	Results in unacceptable situation or byproduct	N/A	
Biohazard	Special controls required	N/A	
Asphyxiants	Affects large number of or any unsuspecting people	N/A	
Other or Unknown		N/A	

\*Note: N/A = The hazard does not exist for this activity  
Screen Out = The hazard exists but does not exceed the criterion  
Keep = The hazard exists such that it exceeds the criterion

Center for Nanophase Materials Science			
Anticipated Inventory of Chemicals and Gases			
<b>Hard Materials Synthesis and Characterization</b>			
<i>Chemicals</i>		<i>In Use</i>	<i>In Storage</i>
	Examples	Quantity	
Pyrophoric (active metals)	Magnesium	1.5 kg	1kg
Flammable and combustible liquids	Acetone, alcohols	100 L	50 L
Caustic and corrosive liquids	Acids, bases	40 L	20 L
Explosives		0 g	0 g
Shock Sensitive		0 g	0 g
Peroxides		0 g	0 g
Highly toxic materials		20 kg	5 kg
<b>Gases</b>		<b>Cylinders</b>	
Flammable gases	Hydrogen	4	3
	Acetylene	3	2
	Argon + 4% Hydrogen	3	2
Oxidizing gases	Oxygen	10	5
	Nitrous oxide	2	1
Nonreactive gases	Argon	25	12
	Krypton	7	3
	Nitrogen	14	7
	Helium	6	3
	Trifluoromethane	4	2
Reactive/hazardous gases	Ammonia	2	1
	Hydrogen chloride	1	1
	Acetylene	3	1
	Chlorine*	3	1
	Fluorine	1	1
Mixed gases	Phosphine (in hydrogen)	1	0
	Chlorine (in helium)	1	0
	Hydrogen chloride (in helium)	5	2
	Oxygen (in argon)	4	2
	Hydrogen (in argon)	4	2
	Hydrogen (in air)	1	0
	Ammonia (in hydrogen)	1	0
*Lecture or half-size cylinder			

Center for Nanophase Materials Science			
Anticipated Inventory of Chemicals and Gases			
Soft Materials Synthesis and Characterization			
Chemicals		In Use	In Storage
	Examples	Quantity	
Pyrophoric (active metals)	Na, K	5 kg	2 kg
Flammable and combustible liquids	Acetone, ethers	800L	200L
Caustic and corrosive liquids	HCl, HNO <sub>3</sub> , NaOH, NH <sub>4</sub> OH	120 L	40 L
Explosives	TNT?	<<10 g	0 g
Shock Sensitive	Picric acid	<100 g	0 g
Peroxides	Benzoyl peroxide	< 2 lb	< 1 lb
Highly toxic materials	Carcinogens, etc.	< 10 kg	< 2 kg
Gases		Cylinders	
Flammable gases	Hydrogen	2	2
	Propane	2	2
	Argon + 4% Hydrogen	1	1
Oxidizing gases	Oxygen	2	2
	Nitrous oxide	1	1
Nonreactive gases	Argon	5	5
	Carbon dioxide	4	4
	Helium	4	4
Reactive gases (small cylinders)	Ammonia	1	1
	Hydrogen chloride	1	1
	Acetylene	1	1
	Calibration gas mixtures	2	2
Totals in Main CNMS Laboratory Complex			
Chemicals		In Use	In Storage
		Quantity	
Pyrophoric (active metals)		6.5 kg	3 kg
Flammable and combustible liquids		900 L	250 L
Caustic and corrosive liquids		160 L	60 L
Explosives		<<10 g	0 g
Shock Sensitive (Picric Acid)		<100 g	0 g
Peroxides		<1 kg	<500 g
Highly toxic materials		30 kg	7 kg
Gases		Cylinders	
	Flammable gases	17	14
	Oxidizing gases	15	9
	Nonreactive gases	67	40
	Reactive, hazardous, and mixed gases		
	Full cylinders	26	11
	Half or lecture cylinders	17	5

Center for Nanophase Materials Science			
Anticipated Inventory of Chemicals and Gases			
Nanoscale Fabrication Facility			
Chemicals		In Use	In Storage
	Examples	Quantity	
Pyrophoric (active metals)	Magnesium	0	0
Flammable and combustible liquids	Acetone, alcohols	120L	120L
Caustic and corrosive liquids	Acids, bases	400L	400L
Explosives		0	0
Shock Sensitive		0	0
Peroxides	Hydrogen peroxide solution	10L	10L
Highly toxic materials		0	0
Gases		Cylinders	
Flammable gases	Hydrogen	3	2
	Helium + 4% Hydrogen	1	1
Oxidizing gases	Oxygen	4	2
	Carbon tetrafluoride in oxygen	3	1
Nonreactive gases	Argon	3	1
	Nitrogen dioxide	2	1
	Sulfur Hexafluoride	1	0
	C4F8	2	1
	Trifluoromethane	2	1
	Tetrafluoromethane	4	2
	Helium	1	1
Reactive/hazardous gases	Ammonia	4	2
	Chlorine	2	1
	Phosphine	3	1
	Diborane	2	1
	Arsine	2	1
	Boron trichloride	2	1
	Silane	2	1
	Dichlorosilane	1	1
	Hexamethyldisilazane	2	1
Totals in CNMS Nanoscale Fabrication Research Facility			
Chemicals		In Use	In Storage
		Quantity	
Pyrophoric (active metals)		0	0
Flammable and combustible liquids		120L	120L
Caustic and corrosive liquids		400L	400L
Explosives		0	0
Shock Sensitive		0	0
Peroxides		10L	10L
Highly toxic materials		0	0
Gases		Cylinders	
	Flammable gases	4	3
	Oxidizing gases	7	3
	Nonreactive gases	15	7
	Reactive, hazardous, and mixed gases	20	10